

CATASTROPHIC MORTALITY OF BREEDING TROPICAL ROCK LOBSTERS

In August–September each year many 3–4 year old sub-adult *Panulirus ornatus* emigrate from Torres Strait, north-eastern Australia, into the Gulf of Papua; some migrate as far as Yule Island at the eastern side of the gulf, appearing in breeding condition on shallow coastal reefs by mid-January (Moore and MacFarlane, 1984; MacFarlane and Moore, 1986; Bell *et al.*, 1987). There is a seasonal artisanal fishery for these breeding lobsters, but it lasts only a few months. The breeding lobsters are in poor condition and it has been hypothesised that they invest so much energy in the migration and in reproduction that death is inevitable (Trendall and Prescott, 1989). However, the population could also decline as a result of fishing pressure or emigration from the fishing grounds. These alternative explanations of the annual decline of the breeding population were investigated in early 1989.

Methods

In order to distinguish between the three hypotheses it was necessary to estimate natural and fishing mortality, and immigration and emigration rates. A variety of methods were used to estimate these parameters; (a) tangle nets were deployed in deep water adjacent to the coastal reefs to reveal the extent of movements on and off the reefs, (b) the catch and effort of the fishery were analysed to indicate trends in abundance, (c) lobsters were tagged and their recapture rate was monitored to provide an estimate of population size and loss rates, and (d) the water content of samples of digestive gland was measured to show trends in physiological condition.

Results and Discussion

The Yule Island fishery followed a typical pattern over the period January–March 1989, with two major peaks in catch following monsoonal storms before waning through March. The sex ratio of the first peak was close to unity whereas prior to this the catch consisted mostly of males and the second peak comprised almost entirely females.

The tangle nets caught lobsters in two pulses in synchrony with the January and February full moons. However, these pulses were considered not to indicate emigration because (i) catch rates from the reef top peaked immediately afterwards, (ii) several animals tagged from the nets were caught later by the fishery, and (iii) through March, when the catch of the fishery declined rapidly, no associated movement of lobsters off the coastal reefs was revealed by the nets. Instead, the pulses were interpreted as lunar hatching excursions as they comprised almost entirely females with evidence of recently hatched broods.

Analysis both of the tagging and catch data indicated extraordinarily high total loss rates ($Z = 10\text{--}12$) compared with lobsters in Torres Strait ($Z < 1$); indeed, of the 20,000–30,000 lobsters estimated to be present at the beginning of the study more than 95% disappeared during the following few months. The tag return rate was high indicating that

fishing pressure was responsible for much of the decline ($F = 3\text{--}4$), but the natural mortality rate over the period was even higher ($M = 7\text{--}8$) possibly as a result of the stress of migration and breeding.

This interpretation is supported by trends in the water content of the digestive gland. The water content (60% in healthy lobsters) increased steadily to 80% by early March after which it declined slightly; this apparent recovery may have resulted from animals with the highest water content dying at a faster rate. The degree of deterioration was greater in females and the recovery was more marked in the very few males remaining in the fishery at this time. Prior to this physiological recovery, recently moulted lobsters were very rare. However, in the final weeks of the fishery nearly all males caught had moulted recently and their mortality rate had reduced to an unmeasurable level. In contrast, moulting was not observed in females and their mortality rate remained very high throughout the study.

It is clear that lobsters breeding on coastal reefs near Yule Island do not survive to breed again in subsequent years. This raises the question of the generality of this phenomenon among other breeding populations of *P. ornatus* that have been discovered recently in deep water adjacent to the far northern Great Barrier Reef of Australia.

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Literature Cited

- Bell, R.S., Channells, P.W., MacFarlane, J.W., Moore, R. and Phillips, B.F. 1987. Movements and breeding of the ornate rock lobster, *Panulirus ornatus*, in Torres Strait and the northeast coast of Queensland. *Australian Journal of Marine and Freshwater Research* 38: 197–210.
- MacFarlane, J.W. and Moore, R. 1986. Reproduction of the ornate rock lobster, *Panulirus ornatus* (Fabricius), in Papua New Guinea. *Australian Journal of Marine and Freshwater Research* 37: 55–65.
- Moore, R. and MacFarlane, J.W. 1984. Migration of the ornate rock lobster, *Panulirus ornatus* (Fabricius), in Papua New Guinea. *Australian Journal of Marine and Freshwater Research* 35: 197–212.
- Trendall, J.T. and Prescott, J.H. 1989. Severe physiological stress associated with the annual breeding emigration of *Panulirus ornatus* in the Torres Strait. *Marine Ecology Progress Series* 58: 29–39.
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